GEOTECHNICAL INVESTIGATION AND
SOIL QUALITY RECONNAISSANCE
FOR
CONCRETE BOX CULVERT
MORGAN HILL, CALIFORNIA

LOWNEY ASSOCIATES
Environmental/Geotechnical/Engineering Services

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LOWNEY ASSOCIATES
ENVIRONMENTAL/GEOTECHNICAL/ENGINEERING SERVICES

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Environmental / Geotechnical / Engineering Services

October 23, 1991
10-109-14, MV081309

SANTA CLARA VALLEY WATER DISTRICT
6489 Camden Avenue
San Jose, California 95120

RE: GEOTECHNICAL INVESTIGATION AND SOIL QUALITY RECONNAISSANCE FOR CONCRETE BOX CULVERT MORGAN HILL, CALIFORNIA

Attention: Mr. Sam Seyed Hosseini

Gentlemen:

In accordance with your request, we have performed a geotechnical investigation and a soil quality reconnaissance for the above referenced project. The accompanying report presents the results of our field investigation work, laboratory tests, and engineering analyses. The soil and foundation conditions are discussed, and recommendations for the geotechnical engineering aspects of the project are presented.

If you have any questions concerning our findings, please call me, Daren Thomas or Chris Trumbull.

Very truly yours,

LOWNEY ASSOCIATES

Glenn A. Romig

GLENN A ROMIG
002157
Exp. 12-31-93

GAR:DLT:CDT

Copies: Addressee (10)

EXECUTIVE SUMMARY

Lowney Associates has been retained by the Santa Clara Valley Water District to perform a geotechnical investigation for the proposed improvements to the existing concrete box culvert to be located mainly in the Lucky grocery store parking lot near the southwest corner of the intersection of West Dunne Avenue and Monterey Road in Morgan Hill, California. The purpose of the investigation has been to assess the subsurface conditions and to provide recommendations concerning the geotechnical engineering aspects of the project. In addition, a soil quality reconnaissance was also performed. Principal results, conclusions and recommendations are presented below.

GEOTECHNICAL INVESTIGATION

1. The site is underlain by firm to very stiff silty clays and medium dense to dense clayey sands. In our opinion, these soils will provide adequate bearing for the proposed culvert and wingwalls.

2. Free ground water was encountered in borings EB-6 and EB-7 during drilling at depths of 19 and 18 feet, respectively. Free groundwater was not encountered in any of the remaining borings at the time of drilling. It should be noted, however, that the borings may not have been left open for sufficient time to detect any inflow of ground water through the surrounding stiff silty clays.

3. The site is likely to experience strong seismic shaking during a moderate to severe earthquake such as may be expected to affect the San Francisco Bay Area during the next 50 years. In our opinion, the probability of damage to the culvert from other geologic hazards, namely fault rupture, liquefaction, lateral spreading, and differential compaction, is low.

4. The concrete box culvert wingwalls may be supported on conventional continuous and/or isolated spread footings bearing on native soil or compacted structural fill. All footings should extend at least 18 inches below lowest adjacent finished grade and can be designed for maximum allowable

bearing pressures of 2,500 pounds per square foot for dead loads, 3,500 pounds per square foot for combined dead and live loads, and a one-third increase for all loads, including wind or seismic. We estimate that post-construction differential settlement due to static loads should be less than 1/2 inch across any 100 foot section of the proposed box culvert during the 30-year period following completion of the project. Post-construction differential settlement due to static loads should be less than 1/2 inch across each wingwall during the 30-year period following completion of the project.

SOIL QUALITY RECONNAISSANCE

5. To help evaluate if the on-site soils have been impacted by possible nearby gasoline service station tank leaks, four soil samples were collected at selected depths from selected borings close to the nearby service stations and analyzed for oil and grease, gasoline and BTEX compounds, and diesel fuel.

6. Laboratory analysis of the soil samples for oil and grease and gasoline and BTEX indicated results below laboratory detection limits. In addition, all samples tested for diesel indicated non-detectable results except one sample from boring EB-1. This sample, collected at a depth of 5 to 5.5 feet, indicated 1.3 ppm diesel, which is just above the laboratory detection limit of 1.0 ppm. In our opinion, no further work is required. The low diesel concentration may be the result of laboratory contamination or, if present in the soil, does not indicate that hydrocarbons of concern are present.

* * * * * * * * * * *

GEOTECHNICAL INVESTIGATION AND SOIL QUALITY RECONNAISSANCE

For

CONCRETE BOX CULVERT
Morgan Hill, California

To

SANTA CLARA VALLEY WATER DISTRICT
6489 Camden Avenue
San Jose, California 95120

October 1991

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GEOTECHNICAL INVESTIGATION AND
SOIL QUALITY RECONNAISSANCE
FOR
CONCRETE BOX CULVERT
MORGAN HILL, CALIFORNIA

INTRODUCTION

In this report, we present the results of our geotechnical investigation for the proposed concrete box culvert addition between Ciolino Avenue and West Dunne Avenue in Morgan Hill, California, as shown on the Vicinity Map, Figure 1. The purpose of this investigation was to evaluate the foundation materials and to provide recommendations concerning the subsurface and geotechnical engineering aspects of the project. In addition, we evaluated the quality of selected soil samples for hydrocarbon compounds.

Project Description

As presently planned, the project will consist of a new concrete box culvert addition adjacent to the existing culvert. The existing culvert carries water from West Little Llagas Creek. In addition, at West Dunne Avenue, a 10 by 8 foot precast concrete box culvert will be constructed as well as a 15 by 8 foot reinforced concrete box culvert at Ciolino Avenue. The excavation required for the culvert installation will be approximately 11 feet deep. According to your structural details, permeable material over a geotextile fabric is planned below the 11 inch concrete culvert base. The culvert will be covered with approximately 18 inches of fill.

SCOPE

The scope of work performed in this investigation included a site reconnaissance, subsurface exploration, laboratory testing, engineering analysis of the field and laboratory data, and the preparation of this report. The data obtained and the analyses performed were for the purpose of providing design criteria for site earthwork, pavements, lateral earth pressures, and wingwalls. The scope of work was presented in detail in our agreement with you.

The purposes of our investigation were to provide geotechnical design recommendations for the proposed construction and to evaluate the environmental setting on a reconnaissance basis. In order to accomplish these tasks, we have performed the following services:

1. Exploration of the subsurface soil conditions by drilling seven borings and obtaining relatively undisturbed soil samples for visual observation and laboratory testing.

2. Evaluation of the physical and engineering properties of the subsurface soils by observing the samples and performing various laboratory tests on representative samples.

3. Engineering analysis to evaluate site earthwork, wingwall foundations, and lateral earth pressures from a geotechnical engineering viewpoint.

4. Chemical analysis of four selected soil samples for total petroleum hydrocarbons as diesel gasoline with scans for benzene, toluene,

ethylbenzene and xylenes and oil and grease. Soil samples from each of the selected sample locations were also monitored with an Organic Vapor Meter (OVM).

5. Preparation of this report as a summary of our findings and to present our conclusions and recommendations.

This report has been prepared for the use of Santa Clara Valley Water District (SCVWD) for application to the design of the proposed concrete box culvert in accordance with generally accepted geotechnical engineering practices. No warranty is expressed or implied.

The investigation was conducted under the direction and review of Glenn A. Romig, G.E., Principal Geotechnical Engineer and Daren L. Thomas, P.E., Associate Engineer. Supervision of the subsurface exploration, laboratory testing and the engineering analyses were performed by Christopher D. Trumbull, Staff Engineer.

SITE INVESTIGATION

Exploration Program

Subsurface exploration and surface reconnaissance were performed on July 30, 1991 using a truck-mounted, 6-inch diameter continuous flight auger to explore and sample the subsurface soils. Seven exploratory borings were drilled to depths of 20 feet at the locations shown on the Site Plan, Figure 2. Logs of our borings and details regarding our field investigation are included in Appendix A; the results of our laboratory tests are discussed in Appendix B.

The borings were backfilled per Santa Clara Valley Water District requirements.

Surface

At the time of our exploration program, the site consisted mostly of asphalt parking and traffic channels, with adjacent retail and grocery stores, and two service stations (B.P. and Unocal). The B.P. station is located west of the culvert alignment, just south of W. Dunne Avenue. The Unocal station is located west of the culvert at the north end of the study area. All seven borings were drilled in asphalt parking areas or parking channels of the Lucky store in the SCVWD easement.

Subsurface

Based on the findings of our subsurface exploration program, the soils at the site can be roughly grouped into four strata as described below.

Stratum A: Low to High Plasticity, Firm to Hard, Silty Clay with Sand (CL), Silty Clay (CL/CH, CH), Sandy Silty Clay (CL/CH), Gravelly Clay with Sand (CL/CH), and Sandy Clay (CL).

Brown, dark brown, and black, low to high plasticity, firm to hard silty clay with sand, silty clay, sandy silty clay, gravelly clay with sand, and sandy clay (CL, CL/CH, CH). This stratum was encountered immediately below the asphaltic concrete at the surface and extended to depths of 3 to 17.5 feet. Water contents ranging from 9 to 20 percent were measured. Two Atterberg limit determinations were performed on selected samples from this stratum and indicated a plasticity indices of 19 and 20 percent and liquid limits of 34 and 35 percent, respectively. Measured Torvane shear strength values ranging from 1.5 to greater than 4.5 kips per square foot were recorded.

Stratum B: Medium Dense to Dense Clayey Sand with Gravel (SC), Silty Sand (SM), Gravelly Clayey Sand (SC), and Clayey Gravelly Sand (SC).
Brown and gray, medium dense to dense clayey sand with gravel, silty sand, gravelly clayey sand, and clayey gravelly sand (SC, SM). This stratum was encountered below Stratum A to depths ranging from 4 feet to the maximum depth explored. Water contents ranging from 9 to 17 percent were measured. Three washed sieve analyses were performed on samples from this stratum and indicated 15, 18, and 23 percent fines passing the No. 200 sieve by weight. Standard penetration resistance blow count values ranging from 17 to 58 blows per foot were recorded.

Stratum C: Low Plasticity, Firm to Very Stiff Silty Clay (CL).
Brown, low plasticity, firm to very stiff silty clay (CL). This stratum was encountered below Stratum B to depths ranging between 16.5 and 17 feet in borings EB-1 and EB-2 and was encountered to the maximum depth explored in boring EB-3. This stratum was interbedded with Stratum B in borings EB-4 and EB-5 and was not encountered in borings EB-6 and EB-7. Water contents ranging from 13 to 24 percent were measured. Measured Torvane shear strength values ranging from 0.8 to 3.5 kips per square foot were recorded.

Stratum D: Low Plasticity, Firm/Loose to Medium Dense Sandy Clay/Clayey Sand (CL/SC).
Brown, low plasticity, firm/loose to medium dense sandy clay/clayey sand (CL/SC). This stratum was encountered below Stratum C to the maximum

depth explored in borings EB-1 and EB-2 only. Water contents ranging from 22 to 23 percent were measured. Two washed sieve analyses were performed on samples from this stratum and indicated 51 and 52 percent fines passing the No. 200 sieve by weight. Measured Torvane shear strength values of 0.8 kips per square foot were recorded. Standard penetration resistance blow count values ranging from 9 and 17 blows per foot were recorded.

Ground Water

Free ground water was encountered in borings EB-6 and EB-7 at depths of 18 and 19 feet, respectively. Please note, however, that fluctuations in the level of the ground water may occur due to variations in rainfall and other factors not in evidence at the time measurements were made.

Geologic Hazards

A brief qualitative evaluation of certain geologic hazards was made during this investigation. Our comments concerning these hazards are presented below:

1. Fault Rupture - No known active faults are believed to exist within the site, and fault rupture is therefore not anticipated.

2. Ground Shaking - Strong ground shaking can be expected at the site during moderate to severe earthquakes in the general region. This is typical of the San Francisco Bay Area.

3. Liquefaction - Soil liquefaction results from loss of strength during cyclic loading, such as imposed by earthquakes. Soils that are most susceptible to liquefaction are clean, loose,

saturated, uniformly graded, fine-grained sands. Empirical evidence indicates that loose silty sands are also potentially liquefiable. The sands encountered in the borings contained a significant amount of fines, were capped with clay layer and were generally not below the water table. A clay cap will help to minimize the venting or surfacing of sands should liquefaction occur. Sands encountered in borings EB-6 and EB-7, where groundwater was encountered, contained a very high fines content that would act as a binder during seismic shaking. Therefore, in our opinion and based on engineering judgement, the probability of liquefaction occurring in the sands encountered in the borings at the site is low during a seismic event.

4. Differential Compaction - The near-surface soils at the site vary in composition both vertically and laterally. Major earthquake shaking could cause non-uniform compaction of the soil strata, resulting in movement of the near-surface soils. Because the soils underlying the proposed culvert were generally stiff and dense, and since abrupt changes in stratification do not appear to occur over short distances, in our opinion, however, and based upon engineering judgement, the probability of such ground movement at the site is low.

5. Lateral Spreading - Lateral spreading can occur as a form of planar failure in both soil and rock masses. Generally, in soils, the soil mass strains along a weak plane and spreads towards an area of stress release (an open body of water,

channel, or excavation) as blocks break free, gradually retrogressing from the area of stress release towards the head. Failure in this mode is generally analytically unpredictable, since it is difficult to predict where the first tension crack will occur.

Maps by Youd and Hoose (1978) indicate no lateral spreading occurring in the site vicinity during the 1906 San Andreas earthquake. In addition, by filling the creek channel with the proposed and existing culvert, the potential for lateral spreading on this reach of the creek is effectively eliminated. Therefore, for these reasons, and based upon engineering judgement, in our opinion, the probability of lateral spreading occurring at the site during a seismic event is low.

Seismicity

The San Francisco Bay Area is recognized by geologists and seismologists as one of the most active regions in the United States. The significant earthquakes which occur in the Bay Area are generally associated with crustal movement along well-defined, active fault zones which regionally trend in a northwesterly direction. The estimated distances from the site to nearby faults and estimated maximum magnitudes of earthquakes associated with those faults are presented in Table 1.

TABLE 1. Summary of Fault Distances and Magnitudes
Concrete Box Culvert,
Morgan Hill, California

Fault	Approximate Distance From Site (miles)	Estimated Maximum Credible Earthquake (Richter Magnitude)
Active:		
San Andreas	8.5	8.3
Calaveras	3.0	7.3
Hayward	28.5	7.3
Potentially Active:		
Sargent	7.5	7.4
Inactive:		
San Jose	9.0	not estimated

Although research on earthquake prediction has greatly increased in recent years, seismologists cannot predict when or where an earthquake will occur. Nevertheless, on the basis of current technology, it is reasonable to assume that the proposed development will be subjected to at least one moderate to severe earthquake during the 50-year period following construction. During such an earthquake, the danger from fault offset on the site is slight, but strong shaking of the site is likely to occur.

Seismic Design Criteria

The maximum credible earthquake is defined as the largest earthquake that appears capable of occurring along a fault in the existing tectonic environment. It is anticipated that the maximum credible earthquake in the site vicinity will occur along the San Andreas Fault with the epicenter located approximately 8.5 miles to the west. This is expected to result in an approximately 8.3 magnitude event with peak rock acceleration estimated at 0.50g and a surface acceleration at 0.42g based upon attenuation curves presented by Seed (1982).

The maximum probable earthquake is a smaller earthquake that can reasonably be expected to occur within the lifetime of the facility with a 60 percent probability of not being exceeded within a 100-year period. Figure 3 shows that an earthquake of magnitude 6.6 occurring in the central section of the San Andreas Fault has a 60 percent probability of not being exceeded in 100 years. Rock acceleration for a 6.6 magnitude earthquake is estimated at 0.35g and surface acceleration at 0.30g based upon attenuation curves presented by Seed (1982).

Site Coefficient

The site coefficient was evaluated in accordance with the 1988 UBC Design Criteria. In general, stiff to very stiff clays and medium dense to dense sands were encountered at the site during our investigation. In addition, based on our conversation with Jim Burkland, Santa Clara County Geologist and our review of California Division of Mines and Geology special report 107, soil depths above bedrock are approximately 150 feet or less in the Morgan Hill area. Therefore, we recommend a Site Factor of 1.0 corresponding to Soil Type S_1 be used in design.

DESIGN RECOMMENDATIONS

Conclusions

From a geotechnical engineering viewpoint, in our opinion, the site is suitable for the proposed development provided the recommendations presented in this report are incorporated in the design and construction of the project.

Plans, Specifications, and Construction Review

Because subsurface conditions may vary considerably from those predicted by relatively small diameter borings, and in order to assure that our report recommendations have been properly implemented, we recommend that we be retained to: 1) review the final construction plans and specifications,and 2) observe the earthwork and foundation installation.

EARTHWORK

Clearing and Site Preparation

The site should be cleared of all surface and subsurface deleterious materials including any buried utility lines, pavements, debris, and designated trees, shrubs, and associated roots. Excavations extending below the planned finished site grades should be cleaned and backfilled with suitable material compacted to the requirements given under the "Compaction" section. We recommend that the backfilling be carried out under our observation.

After clearing, the site should be stripped to sufficient depth to remove all surface vegetation and organic laden topsoil. At the time of our field investigation, we estimated that a stripping depth may not be required except in any landscaped areas within the alignment of the excavation. The actual stripping depth required will depend on site usage prior to construction and, therefore, should be established in the field by us at the time of construction. The stripped materials should be removed from the site or may be stockpiled for use in landscaped areas, if desired.

Subgrade Preparation

After the site has been properly cleared, stripped, and the necessary excavations made, the exposed surface soils in those areas to receive structural fill, slabs-on-grade, or pavements should be scarified to a depth of 6 inches, moisture conditioned to slightly above optimum moisture content, and compacted in accordance with the requirements for structural fill given below under "Compaction."

Material for Fill

All on-site soils having an organic content of less than 3 percent by volume are suitable for use as fill at the site. In general, fill material should not contain rocks or lumps larger than 6 inches in greatest dimension, with no more than 15 percent larger than 2.5 inches. Imported fill material should be predominantly granular with a sand equivalent of 10 or more (ASTM D-2419, latest edition) and a plasticity index of 15 or less.

Compaction

Scarified surface soils in those areas to receive structural fill or culverts and all structural fill should be compacted to at least 90 percent relative compaction as determined by ASTM Test Designation D-1557, latest edition at slightly above laboratory optimum moisture content. Fills greater than 5 feet in thickness should be compacted to at least 95 percent relative compaction for the portion of fill below the upper 5 feet. Fill material should be spread and compacted in lifts not exceeding 8 inches in uncompacted thickness.

Trench Backfill

All utility trenches should be backfilled with compacted structural fill. If on-site soil is used, the material should be placed in lifts not exceeding 8 inches in uncompacted thickness and should be compacted to at least 85 percent relative compaction (ASTM D-1557, latest edition) by mechanical means only. Imported sand may also be used for backfilling trenches provided the sand is compacted to at least 90 percent relative compaction. In all pavement and slab areas, the upper 3 feet of trench backfill should be compacted to at least 90 percent for on-site soils and 95 percent where imported sand backfill is used. In addition, the upper 6-inches in pavement areas should be compacted to 95 percent relative compaction.

Temporary Slopes

The contractor should be responsible for all temporary slopes excavated at the site and the design of any required temporary shoring. Shoring and bracing should be provided by the contractor in accordance with the strictest governing safety standards.

All temporary slopes excavated in the natural clayey and sandy soils and less than 5 feet deep below the ground surface may be cut vertical. All other unshored slopes greater than 5 feet deep should be cut to inclinations of 1:1 (horizontal to vertical). Because of the variable nature of the existing soil, field modifications of temporary cut slopes may be required. Unstable materials encountered on the slopes during the excavation should be trimmed off even if this requires cutting the slope back at flatter inclinations.

Culvert Excavation Support

Support of the walls of the culvert excavation may be accomplished using soldier beams and wood lagging, or by the use of tiebacks or other methods selected by the contractor. This choice should be left to the contractor's judgment since economic considerations and/or the individual contractor's construction experience may determine which method is more appropriate. We recommend that the contractor forward his plan for the above support systems to the structural engineer and geotechnical engineer for review prior to construction. In addition, it should be the contractor's responsibility to undertake a preconstruction survey with benchmarks and photographs of the adjacent parking lot and structures.

Permanent Slopes

All fill slopes and cut slopes in soil should have a maximum slope of 2:1 (horizontal to vertical). Exposed slopes may be subject to minor sloughing and erosion which may require periodic maintenance. We recommend that the slopes be planted to minimize erosion.

Drainage

Finish surface of the constructed culvert surfacing should conform with the existing drainage plan for the parking area such that ponding of water does not occur.

Construction Observation

All grading and earthwork should be performed under the observation of our representative to ensure the site is properly prepared, the selected fill materials are satisfactory, and that placement and compaction of the fills have been performed as required. Sufficient notification to us prior to earthwork is essential. All earthwork should be performed in accordance with the Guide Specifications - Site Earthwork presented in Appendix D. However, the guide specifications are general in nature and the actual project specifications should incorporate all requirements contained in the text of this report.

Variations in soil conditions are possible and may be encountered during construction. In order to permit correlation between the soil data obtained during our field and laboratory investigations and the actual subsurface conditions encountered during construction and to observe conformance with the plans and specifications it is essential that we be retained to perform continuous or intermittent review during the earthwork, excavation and foundation construction phases.

FOUNDATIONS

Wingwall Footings

We recommend that the proposed culvert wingwalls be supported on conventional continuous and/or individual spread footings bearing on natural, undisturbed soil. All footings should extend at least 18 inches below the lowest adjacent finished grade. The lowest adjacent finished grade should be considered as the bottom of the culvert base. All footings can be designed for allowable bearing pressures of 2,500 pounds per square foot for dead loads, 3,500 pounds per square foot for combined dead and live loads, plus a one-third increase for all loads including wind or seismic.

These allowable bearing pressures are net values; the weight of the footing can be neglected for design purposes. Footings should have a minimum width of 14 inches. All footings located adjacent to utility trenches should have their bearing surfaces below an imaginary 1.5:1 (horizontal to vertical) plane projected upward from the bottom edge to the trench.

All continuous footings should be designed with adequate top and bottom reinforcement to provide structural continuity and to permit spanning of local irregularities. It is essential that we observe the footing excavations prior to placement of reinforcing steel.

Culvert Settlement

The proposed concrete culvert will not significantly increase the load on the underlying soils if constructed in accordance with the recommendations presented in this report. Therefore, in our opinion, long term localized settlement of the culvert should be negligible. In paved areas, a differential movement of up to approximately 1/2-inch between the existing and new pavement placed after culvert installation should be expected due to the volume change in the backfill adjacent to the culvert.

Wingwall Settlement

Settlement under static loads imposed upon wingwalls and culvert walls are expected to be within tolerable limits for the proposed structural concrete frame. We estimate that total settlements will be less than 1/2 inch, and post-construction differential settlements across any 100 foot section of the culvert should be less than 1/2 inch over the 30-year period following construction.

Lateral Earth Pressures

The proposed wingwalls and culvert walls should be designed to resist lateral earth pressure from adjoining natural materials and/or backfill as well as from any surcharge loads. Restrained culvert walls should be designed to resist an equivalent fluid pressure of 40 pounds per cubic foot plus a uniform pressure of 8H pounds per square foot, where H is the distance in feet between the base of the culvert and the top of the backfill. As there will be some fill placed above the culvert and paved over, the equivalent fluid pressure would begin at the finished grade elevation above the culvert. Such walls should also be designed to resist an additional uniform pressure equivalent to one-half of any surcharge loads applied at the surface. These pressures assume sufficient drainage behind the walls to prevent any build-up of hydrostatic pressures from surface water infiltration and/or a rise in the ground water level. If no drainage is proposed for culvert walls they may be designed for an equivalent fluid pressure of 80 pounds per cubic foot plus 8H pounds per square foot.

Wingwalls which are unrestrained from movement at the top should be designed for lateral earth pressure given below in Table 2. The unrestrained walls should also be designed to resist an additional uniform pressure equivalent to one-third of any surcharge loads applied at the surface.

TABLE 2. Recommended Lateral Earth Pressure for Wingwalls
Concrete Box Culvert,
Morgan Hill, California

Backfill Inclination (Horizontal to Vertical)	Equivalent Fluid Pressure (Pounds per Cubic Foot)
Horizontal	35
3:1	45
2:1	60
1.5:1	80
1:1	100

Drainage

According to your structural details, drainage is planned both beneath and to approximately 3 feet above the base of the culvert. Weep holes at approximately 2 feet above the base of the culvert are planned also. The planned drainage consists of an approximately 12-inch section of one-inch permeable material above a geotextile separation fabric. In our opinion, this drainage section is adequate to relieve hydrostatic pressure on the base of the culvert.

Adequate drainage for culvert walls may be provided by weep holes with permeable material positioned behind the walls. This system should consist of an 18 inch wide section of Class 2 Permeable Material (California Department of Transportation Standard Specifications, latest revision). Alternatively, the backfill behind the wall may consist of 3/4-inch crushed rock if a geotextile separation fabric such as Mirafi 140 or equivalent is wrapped around the rock. The upper 2 feet should consist of compacted on-site soil.

Miradrain 6000 drainage panels or rolls may be used for wall and base drainage as an alternative to the drain rock and tied into the weep holes. The drainage composite may be used alone and does not need to be accompanied by permeable rock. According to Mirafi Inc.®, the Miradrain 6000 drainage composite has a compressive strength of 15,000 pounds per square foot and a flow rate to 15 gallons per minute per foot of width at 3,600 pounds per square foot and a hydraulic gradient of 1.0. The constructibility of the culvert base on top of geotextile should be considered for this alternative; however, it is expected to be practical.

Compaction Behind Culvert Walls

Backfill placed behind the walls should be compacted to at least 90 percent relative compaction using light compaction equipment. If heavy compaction equipment is used, the walls should be temporarily braced.

Wingwalls and culvert walls should be supported on spread footing foundations designed in accordance with the recommendations presented under the "Footings" section of this report. Lateral load resistance for the walls can be developed in accordance with the recommendations presented immediately below under "Lateral Loads."

Lateral Loads

Lateral loads may be resisted by friction between the footings and the supporting subgrade. A frictional resistance of 0.25 can be used. In addition to the above, lateral resistance may be provided by passive pressures acting against culvert. For lateral resistance in backfill material, we recommend that allowable passive pressures based on an equivalent fluid pressure of 350 pounds per cubic foot be used in design.

PAVEMENTS

Two representative bulk samples of the surface soil from the parking area was obtained, and two "R" (resistance) value tests were performed to provide data for pavement design. The results of the test are included in Appendix B and indicate an "R" value of 23 to be applicable in design for on-site soils. Using estimated traffic indices for various pavement loading requirements, we have developed the following recommended pavement sections using Procedure 608, State of California Department of Transportation.

TABLE 3. Recommended Pavements Design Alternatives
Pavement Components,
Concrete Box Culvert
Morgan Hill, California

Location	Design Aggregate Traffic Index	Total Alter-native	Asphaltic Concrete (Inches)	Caltrans Spec. Aggregate Base Class 2 (Inches)	Subbase* (Inches)	Thickness (Inches)
Automobile	3.5	A	2.25	5.0	0.0	7.25
Parking		B	2.25	3.5	1.5	7.75
Automobile	4.5	A	2.5	6.5	0.0	9.0
Parking		B	2.5	4.5	2.5	9.5
Channel						
Truck	5.0	A	2.75	7.5	0.0	10.25
Access		B	2.75	5.0	3.0	10.75
and						
Parking	5.5	A	3.0	8.5	0.0	11.5
Areas		B	3.0	5.5	3.5	12.0
	6.0	A	3.25	9.5	0.0	12.75
		B	3.25	6.0	4.0	13.25

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* Minimum "R" value of 50

The traffic indices used in our pavement design are considered reasonable values for the proposed development and should provide a pavement life of approximately 20 years with a normal amount of flexible pavement maintenance. Selection of the design traffic parameters, however, was based on engineering judgement and not on an equivalent wheel load analysis furnished to us or developed from a traffic study.

The upper 6 inches of pavement subgrade and all aggregate base and sub-base should be compacted to at least 95 percent relative compaction. Asphaltic concrete, aggregate base and subbase, and preparation of the subgrade should conform to and be placed in accordance with the California Department of Transportation, Standard Specifications, latest edition, except that the test method for compaction should be determined by ASTM D-1557, latest edition.

SOIL QUALITY RECONNAISSANCE

Limitations

The accuracy and reliability of geo- or hydrochemical studies are a reflection of the number and type of samples taken and the extent of the analysis conducted, and is thus inherently limited and dependent upon the resources expended. Our sampling and analytical plan was designed using accepted environmental engineering principles and our judgement for the performance of a reconnaissance soil quality investigation, and was based on the degree of investigation desired by you. It is possible to obtain a greater degree of certainty, if desired, by implementing a more rigorous soil sampling program or by installation of monitoring wells to establish a baseline of ground water quality.

Laboratory Procedures

Four soil samples collected from the selected depths from borings EB-1, EB-2 and EB-3 and were analyzed for oil and grease, and total petroleum diesel and gasoline hydrocarbons with additional scans for benzene, toluene, ethylbenzene, and xylenes. These locations were selected because of their proximity to the service stations along the culvert alignment. The soil samples were also monitored with an organic vapor meter during sampling with no levels above background being detected. Appendix C presents the chain of custody and the test methods used. Appendix A describes the sampling procedures.

Soil Quality Analysis and Results

The laboratory analysis of the soil samples was performed by Sequoia Analytical Laboratory which is certified by CDHS (designees of U.S. Environmental Protection Agency) for the above analyses. The complete results of the chemical analyses performed on the soil samples are shown in Appendix C and summarized in Tables 4.

TABLE 4. Laboratory Analysis of Soil
For Petroleum Hydrocarbons
Concrete Box Culvert,
Morgan Hill, California
(concentrations in ppm)

Sample	Diesel	Benzene	Toluene	Ethyl Benzene	Xylenes	Gasoline	Oil and Grease
EB-1, 9.5-10'	ND	ND	ND	ND	ND	ND	ND
EB-1, 5-5.5'	1.3	ND	ND	ND	ND	ND	ND
EB-3, 9.5-10'	ND	ND	ND	ND	ND	ND	ND
EB-2, 5-5.5'	ND	ND	ND	ND	ND	ND	ND

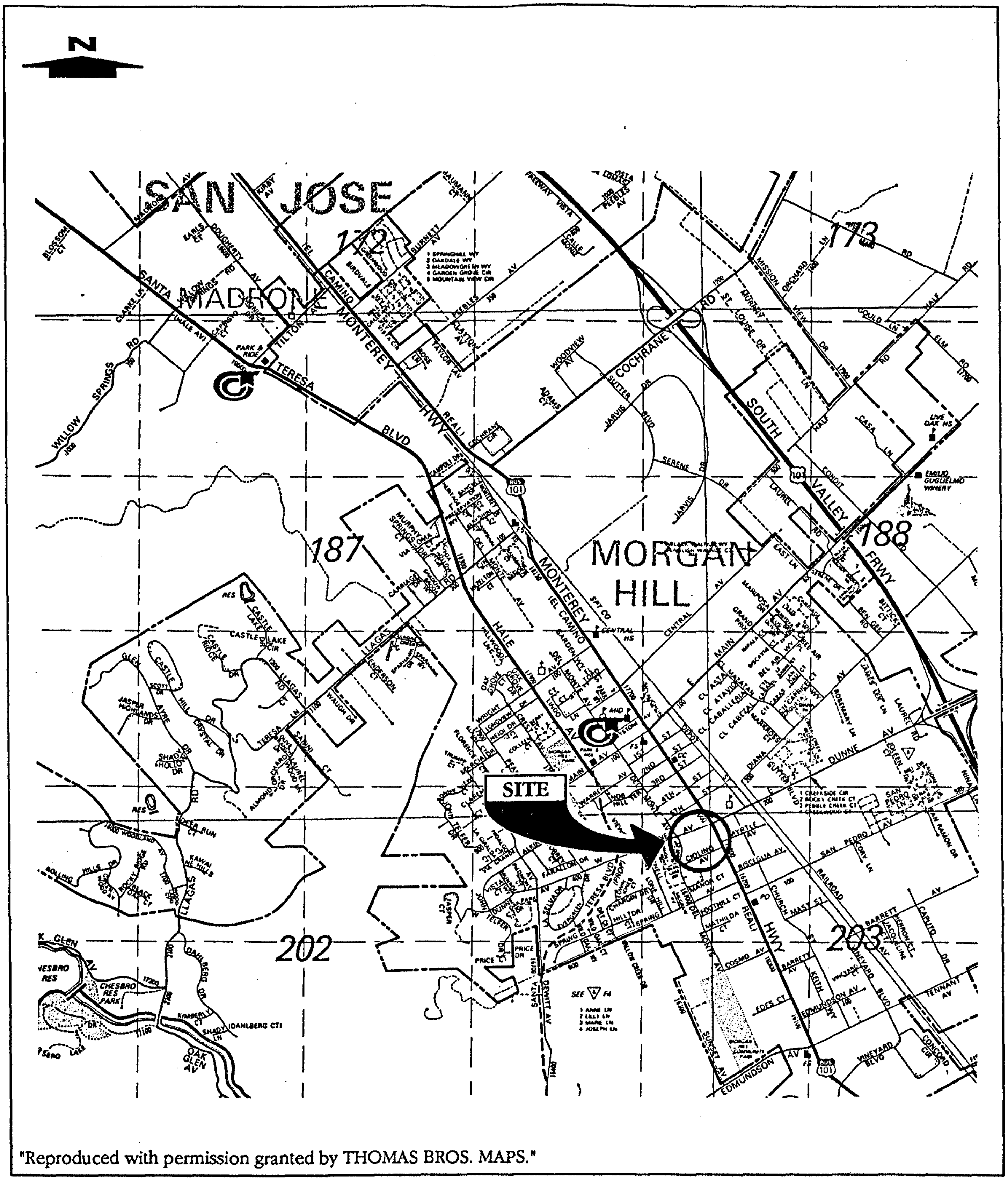
ND = Not Detected

Conclusions

The only compound detected was TPH diesel in the sample from EB-1 at 5 to 5.5 feet, at a concentration of 1.3 parts per million (ppm), which is just above the detection limit for this analysis of 1.0 ppm. The low concentration detected may be the result of laboratory contamination or, if present in the soil, does not indicate that hydrocarbons of concern are present.

Recommendations

No further environmental work is recommended. During construction, at your option, further monitoring or testing could be performed to further confirm the results of this reconnaissance, if desired.



"Reproduced with permission granted by THOMAS BROS. MAPS."

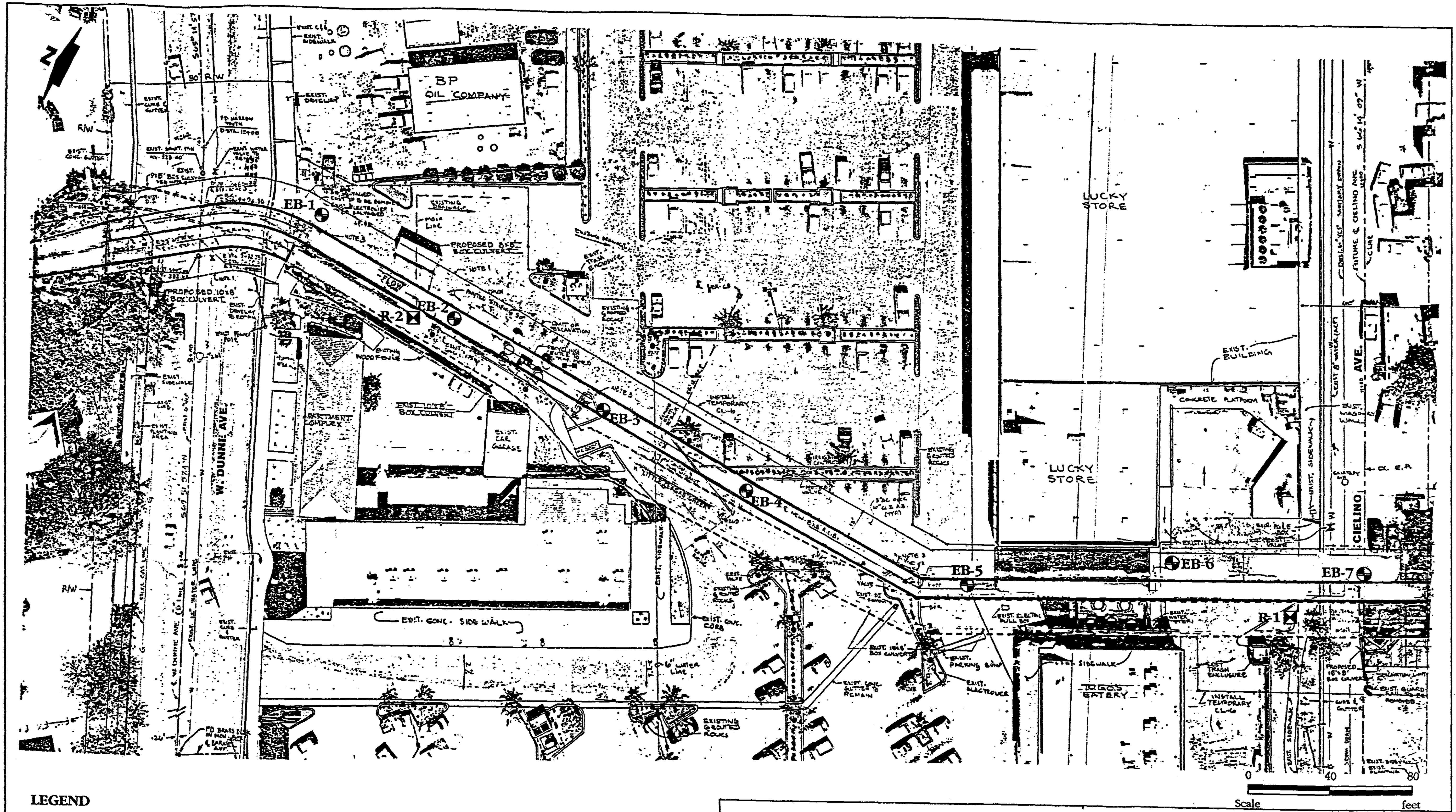
109-14,8/6 CDT*JC

VICINITY MAP

MORGAN HILL BOX CULVERT
Morgan Hill, California

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services

FIGURE 1
109-14, October 1991



LEGEND

- ● - Approximate location of exploratory boring
- ☒ - Approximate location of surface bulk sample

Base by Santa Clara Valley Water District, Dated August 30, 1990.

SITE PLAN

MORGAN HILL BOX CULVERT
Morgan Hill, California

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services

FIGURE 2
109-14, October 1991

P3965,7/15 DLT*JC

LEGEND

● - Approximate location of exploratory boring

▨ - Approximate location of surface bulk sample

EB-1

DRILL RIG: Mobile B-53
SURFACE ELEVATION: –
LOGGED BY: CDT
DEPTH TO GROUNDWATER: Not encountered
BORING DIAMETER: 6-inch continuous flight
DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	CONSISTENCY	SOIL TYPE	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)*
6 inches asphaltic concrete; 4 inches aggregate baserock.							
Brown silty clay with sand, low plasticity, fine to coarse grained sand, trace fine, angular gravel, slight odor.	A	Firm to stiff	CL	13	8	–	–
○ Plasticity Index = 19 percent Liquid limit = 34 percent		Stiff		17	7	1.5	5.0
Brown clayey sand with gravel, fine to coarse grained sand, low plasticity fines, fine angular gravel.	B	Medium dense	SC	15	26	–	–
● 15 percent passing the No. 200 sieve		Dense		14	36	–	–
Brown silty clay, low plasticity.	C	Very stiff	CL	21	21	3.5	8.0
Brown sandy clay/clayey sand, low plasticity, fine grained sand.	D	Firm/ medium dense	CL/ SC				
○ 52 percent passing the No. 200 sieve				23	17	0.8	2.0
Bottom of Boring = 20.0 feet.							

NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual.

* Pocket Penetrometer Strength

EB-2

DRILL RIG: Mobile B-53
SURFACE ELEVATION: –
LOGGED BY: CDT
DEPTH TO GROUNDWATER: Not encountered
BORING DIAMETER: 6-inch continuous flight
DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	CONSISTENCY	SOIL TYPE	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)*
6 inches asphaltic concrete; 4 inches aggregate baserock.							
Black silty clay, moderate plasticity, trace fine grained sand.	A	Very stiff	CL/ CH	17	14	2.5	4.0
				17 17	19	3.5 4.5	7.5 7.5
Brown silty clay with sand, low plasticity, fine grained sand.	A	Hard	CL	10	30	–	–
Brown clayey sand with gravel, fine to coarse grained, low plasticity, fine, angular gravel.	B	Dense	SC				
● 18 percent passing the No. 200 sieve				12	34	–	–
		Medium dense					
Brown silty clay, low plasticity.	C	Very stiff	CL	17 17	26	– 3.5	– 6.0
Brown sandy clay/clayey sand, low plasticity, fine grained sand.	D	Firm/ loose	CL/ SC				
◐ 51 percent passing the No. 200 sieve				22	9	0.8	2.0
Bottom of Boring = 20.0 feet.							

NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual.

* Pocket Penetrometer Strength

EB-3

DRILL RIG: Mobile B-53
SURFACE ELEVATION: –
LOGGED BY: CDT
DEPTH TO GROUNDWATER: Not encountered
BORING DIAMETER: 6-inch continuous flight
DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	CONSISTENCY	SOIL TYPE	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)*
6 inches asphaltic concrete; 4 inches aggregate baserock.							
Dark brown silty clay, moderate plasticity, trace fine grained sand.	A	Very stiff	CL/ CH	18	14	2.5	6.0
				11 9	17	–	–
Gray silty sand, fine to medium grained sand, low plasticity fines.	B	Medium dense	SM	14	4	–	–
Brown silty clay, low plasticity, trace fine grained sand.	C	Firm	CL				
Coarse sand and fine, angular gravel apparent at 8.5 to 10.0 feet.				13	5	–	–
No sand or gravel apparent at 14.0 to 15.0 feet.				18	18	3.5	4.0
Fine grained sand apparent at 18.5 to 20.0 feet.				24	10	0.8	1.5
Bottom of Boring = 20.0 feet.							

NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual.

* Pocket Penetrometer Strength

EB-4

DRILL RIG: Mobile B-53
SURFACE ELEVATION: –
LOGGED BY: CDT
DEPTH TO GROUNDWATER: Not encountered
BORING DIAMETER: 6-inch continuous flight
DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	CONSISTENCY	SOIL TYPE	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)*
4 inches asphaltic concrete; 4 inches aggregate baserock.							
Dark brown sandy silty clay, moderate plasticity, fine to coarse grained sand.	A	Stiff	CL/ CH	15	10	–	–
Dark brown silty clay, low plasticity	A	Very stiff	CL	14	19	3.5	9.0
Trace fine grained sand apparent at 4.0 to 5.5 feet.		Hard		19	28	4.5	9.0
				20 12	30	2.5 –	5.5 –
Brown gravelly clayey sand, fine to coarse grained, moderate plasticity fines, fine, angular gravel.	B	Medium dense to dense	SC				
Brown silty clay, low plasticity	C	Very stiff	CL	21	24	2.5	4.5
Brown gravelly clayey sand, fine to coarse grained, low plasticity fines, fine, angular gravel	B	Very dense	SC	9	58	–	–
Bottom of Boring = 20.0 feet.							

NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual.

* Pocket Penetrometer Strength

EB-5

DRILL RIG: Mobile B-53
SURFACE ELEVATION: –
LOGGED BY: CDT
DEPTH TO GROUNDWATER: Not encountered
BORING DIAMETER: 6-inch continuous flight
DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	CONSISTENCY	SOIL TYPE	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)*
5 inches asphaltic concrete; 5 inches aggregate baserock.							
Brown to dark brown gravelly clay with sand, moderate plasticity, fine to coarse, subrounded to subangular gravel, fine to coarse grained sand.	A	Very stiff	CL/ CH	10	18	–	–
Black silty clay, high plasticity, trace fine grained sand.	A	Stiff	CH	21	17	1.8	4.0
		Very stiff		20 12	18	2.5 –	4.5 –
Brown sandy clay, low plasticity, fine grained sand.	A	Very stiff	CL				
Brown clayey gravelly sand, fine to coarse grained, fine to coarse, angular gravel, low plasticity fines.	B	Medium dense	SC	11	27	–	–
Brown silty clay, low plasticity	C	Very stiff	CL	17 11	22	3.0 –	5.5 –
Brown gravelly silty sand, fine to coarse grained, low plasticity fines, fine, angular gravel	B		SM				
Gravel not apparent at 19.5 to 20.0 feet				11	28	–	–
Bottom of Boring = 20.0 feet							

NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual.

* Pocket Penetrometer Strength

EB-6

DRILL RIG: Mobile B-53
SURFACE ELEVATION: –
LOGGED BY: CDT
DEPTH TO GROUNDWATER: 18.0 feet
BORING DIAMETER: 6-inch continuous flight
DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	CONSISTENCY	SOIL TYPE	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)*
5 inches asphaltic concrete; 5 inches aggregate baserock							
Dark brown silty clay, low to moderate plasticity.	A	Very stiff	CL/ CH	13	16	3.5	6.0
color changes to brown at 2.5 feet.				18	36	3.5	9.0+
		Very stiff		15	30	4.0	9.0+
				16	40	4.0	9.0+
		Very stiff		17 13	21	3.3 –	5.5 –
Brown silty sand, fine to coarse grained, low plasticity fines, trace fine, angular gravel.	B	Medium dense	SM				
○ 23 percent passing the No. 200 sieve							
Gravel content increases at 18.5 to 20.0 feet.				11	38	–	–
Bottom of Boring = 20.0 feet							

NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual.

* Pocket Penetrometer Strength

EB-7

DRILL RIG: Mobile B-53
SURFACE ELEVATION: –
LOGGED BY: CDT
DEPTH TO GROUNDWATER: 19.0 feet
BORING DIAMETER: 6-inch continuous flight
DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	CONSISTENCY	SOIL TYPE	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF)*
5 inches asphaltic concrete; 5 inches aggregate baserock.							
Brown silty clay with sand, low plasticity, fine grained sand.	A	Hard	CL	14	35	4.5+	9.0
○ Plasticity Index = 20 percent Liquid Limit = 35 percent				15	42	4.5+	9.0+
				17	32	4.5	8.0
		Very stiff		16	27	2.5	6.0
				20	20	2.8	7.0
Brown clayey sand with gravel, fine to coarse grained, low plasticity fines, fine, angular gravel.	B	Dense	SC	11	40	–	–
Bottom of Boring = 20.0 feet							

NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual.

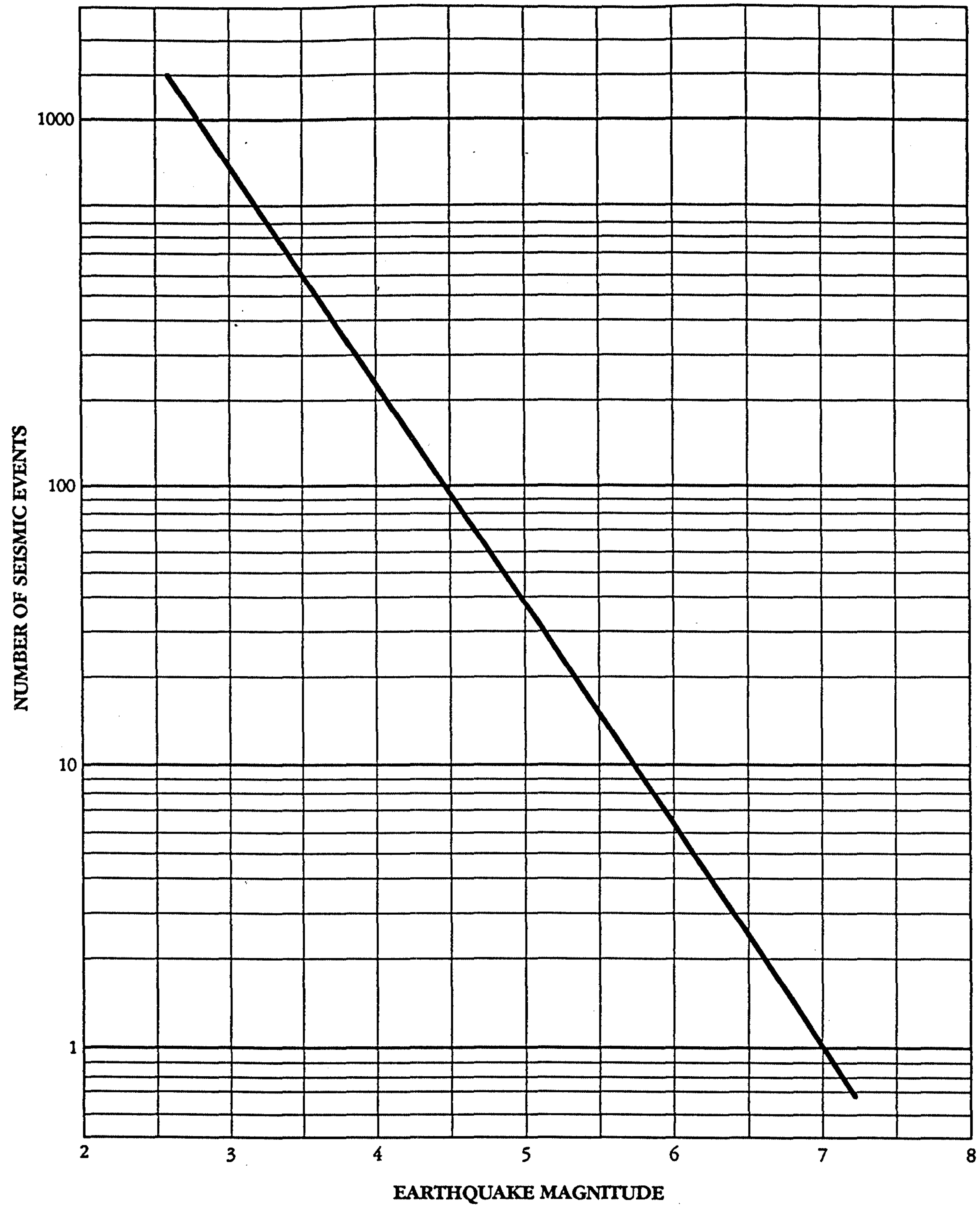
* Pocket Penetrometer Strength

Base by Santa Clara Valley Water District, dated August 30, 1990.

LOWNEY ASSOCIATES
Environmental/Geotechnical/Engineering Services

EXPLORATORY BORING LOG

SCALE:	APPROVED BY: GAR	DRAWN BY JC
DATE: October 1991		REVISED
MORGAN HILL BOX CULVERT Morgan Hill, California		DRAWING NUMBER 3



109-14,9/4 CDT*JC

EMPIRICAL RELATIONSHIP BETWEEN NUMBER OF OCCURENCES AND MAGNITUDE

MORGAN HILL BOX CULVERT
Morgan Hill, California

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services

FIGURE 3
109-14, October 1991

APPENDIX A - FIELD INVESTIGATION

The field investigation consisted of a surface reconnaissance and a subsurface exploration program using a truck-mounted, hollow-stem auger. Seven 6-inch diameter exploratory borings were drilled on August 30, 1991, to a maximum depth of 20 feet. The approximate locations of the exploratory borings are shown on the Site Plan, Figure 2. The soils encountered were continuously logged in the field by our representative and described in accordance with the United Soil Classification System (ASTM D-2487). The logs of the borings, as well as a key to the classification of the soil, are included as part of this appendix.

The locations of borings were approximately determined by cloth tape. The location and elevation of the borings should be considered accurate only to the degree implied by the method used.

Representative soil samples were obtained from the borings at selected depths. All samples were returned to our laboratory for evaluation and appropriate testing. The standard penetration resistance blow counts were obtained by dropping a 140-pound hammer through a 30-inch free fall. The 2-inch O.D. split spoon sampler was driven 18 inches and the number of blows was recorded for each 6 inches of penetration. Unless otherwise indicated, the blows per foot recorded on the boring log represent the accumulated number of blows required to drive the last 12 inches.

When obtaining selected soils samples for gas, diesel, BTE & X, and oil and grease analysis, all sampling equipment was thoroughly cleaned with a tri-sodium phosphate and distilled water solution or steam cleaned. Soil samples were collected using a 1.5 inch O.D. Standard Penetration split spoon sampler or 2.5-inch O.D. California Modified drive sampler. Upon collection from the sampler, the ends of the brass liner were covered with aluminum foil and then sealed with a plastic cap at each end. The caps were taped airtight and labeled appropriately. These samples were then immediately placed on ice for transport to a certified analytical laboratory.

Field tests included an evaluation of the undrained shear strength of soil samples using a Torvane device, and/or the unconfined compressive strength of the soil samples using a pocket penetrometer device. The results of these tests are presented on the individual boring logs at the appropriate sample depth.

The attached boring logs and related information depict subsurface conditions only at the locations indicated and at the particular date designated on the logs. Subsurface conditions at other locations may differ from conditions occurring at these boring locations. The passage of time may result in altered subsurface conditions due to environmental changes. In addition, any stratification lines on the logs represent the approximate boundary between soil types and the transition may be gradual.

PRIMARY DIVISIONS			SOIL TYPE	LEGEND	SECONDARY DIVISIONS
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	░	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	▒	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVEL WITH FINES	GM	▥	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	▨	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	░	Well graded sands, gravelly sands, little or no fines.
			SP	▒	Poorly graded sands or gravelly sands, little or no fines.
		SANDS WITH FINES	SM	▦	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	▨	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT IS LESS THAN 50%		ML	▥	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	▨	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	⁞	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS LIQUID LIMIT IS GREATER THAN 50%		MH	▥	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	▨	Inorganic clays of high plasticity, fat clays.
			OH	▨	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	〰	Peat and other highly organic soils.

DEFINITION OF TERMS

	U.S. STANDARD SERIES SIEVE				CLEAR SQUARE SIEVE OPENINGS		
	200	40	10	4	3/4"	3"	12"
SILTS AND CLAY	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

GRAIN SIZES

▥	TERZAGHI SPLIT SPOON STANDARD PENETRATION
▥	MODIFIED CALIFORNIA
▥	SHELBY TUBE PITCHER TUBE

SAMPLERS

SAND AND GRAVEL	BLOWS/FOOT*
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	OVER 50

RELATIVE DENSITY

SILTS AND CLAYS	STRENGTH‡	BLOWS/FOOT*
VERY SOFT	0 - 1/4	0 - 2
SOFT	1/4 - 1/2	2 - 4
FIRM	1/2 - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	OVER 4	OVER 32

CONSISTENCY

* Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) split spoon (ASTM D-1586).

‡ Unconfined compressive strength in tons/sq. ft. as determined by laboratory testing or approximated by the standard penetration test (ASTM D-1586), pocket penetrometer, torvane, or visual observation.

KEY TO EXPLORATORY BORING LOGS
Unified Soil Classification System (ASTM D - 2487)

MORGAN HILL BOX CULVERT
Morgan Hill, California

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services

FIGURE A - 1
109-14, October 1991

DRILL RIG: Mobile B-53
SURFACE ELEVATION: –
LOGGED BY: CDT
DEPTH TO GROUNDWATER: Not encountered
BORING DIAMETER: 6-inch continuous flight
DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	LEGEND	CONSISTENCY	SOIL TYPE	DEPTH (FEET)	SAMPLER	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF) *
6 inches asphaltic concrete; 4 inches aggregate baserock.										
Brown silty clay with sand, low plasticity, fine to coarse grained sand, trace fine, angular gravel, slight odor.	A	▨	Firm to stiff	CL		■ ○	13	8	–	–
○ Plasticity Index = 19 percent Liquid limit = 34 percent		▨	Stiff			■	17	7	1.5	5.0
Brown clayey sand with gravel, fine to coarse grained sand, low plasticity fines, fine angular gravel. ● 15 percent passing the No. 200 sieve	B	▨	Medium dense	SC	5	■ ●	15	26	–	–
		▨	Dense			■	14	36	–	–
					10					
Brown silty clay, low plasticity.	C	▨	Very stiff	CL		■	21	21	3.3	8.0
					15					
Brown sandy clay/clayey sand, low plasticity, fine grained sand. ⊙ 52 percent passing the No. 200 sieve	D	▨	Firm/ medium dense	CL/ SC		■ ⊙	23	17	0.8	2.0
Bottom of Boring = 20.0 feet.					20					
					25					
					30					

NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual.

* Pocket Penetrometer Strength

109-14,8/6 CDT*JC

EXPLORATORY BORING LOG - EB-1

MORGAN HILL BOX CULVERT
Morgan Hill, California

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services

DRILL RIG: Mobile B-53
SURFACE ELEVATION: –
LOGGED BY: CDT
DEPTH TO GROUNDWATER: Not encountered
BORING DIAMETER: 6-inch continuous flight
DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	LEGEND	CONSISTENCY	SOIL TYPE	DEPTH (FEET)	SAMPLER	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF) *
6 inches asphaltic concrete; 4 inches aggregate baserock.										
Black silty clay, moderate plasticity, trace fine grained sand.	A		Very stiff	CL/CH			17 17 17	14 19	2.5 3.3 4.3	4.0 7.5 7.5
Brown silty clay with sand, low plasticity, fine grained sand.	A		Hard	CL	5		10	30	–	–
Brown clayey sand with gravel, fine to coarse grained, low plasticity, fine, angular gravel. ● 18 percent passing the No. 200 sieve	B		Dense Medium dense	SC	10	●	12	34	–	–
Brown silty clay, low plasticity.	C		Very stiff	CL	15		17 17	26	– 3.5	– 6.0
Brown sandy clay/clayey sand, low plasticity, fine grained sand. ⊙ 51 percent passing the No. 200 sieve	D		Firm/ loose	CL/ SC	20	⊙	22	9	0.8	2.0
Bottom of Boring = 20.0 feet.					25 30					

NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual.

* Pocket Penetrometer Strength

109-14,8/6 CDT*JC

EXPLORATORY BORING LOG - EB-2

MORGAN HILL BOX CULVERT
Morgan Hill, California

LOWNEY ASSOCIATES
Environmental/Geotechnical/Engineering Services

DRILL RIG: Mobile B-53 SURFACE ELEVATION: – LOGGED BY: CDT

DEPTH TO GROUNDWATER: Not encountered BORING DIAMETER: 6-inch continuous flight DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	LEGEND	CONSISTENCY	SOIL TYPE	DEPTH (FEET)	SAMPLER	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF) *
6 inches asphaltic concrete; 4 inches aggregate baserock.										
Dark brown silty clay, moderate plasticity, trace fine grained sand.	A	▨	Very stiff	CL/CH		▩	18	14	2.3	6.0
						▩	11 9	17	–	–
Gray silty sand, fine to medium grained sand, low plasticity fines.	B	▦	Medium dense	SM		▩	14	4	–	–
Brown silty clay, low plasticity, trace fine grained sand.	C	▨	Firm	CL	5					
Coarse sand and fine, angular gravel apparent at 8.5 to 10.0 feet.		▨			10	▩	13	5	–	–
No sand or gravel apparent at 14.0 to 15.0 feet.		▨			15	▩	18	18	3.3	4.0
Fine grained sand apparent at 18.5 to 20.0 feet.		▨			20	▩	24	10	0.8	1.5
Bottom of Boring = 20.0 feet.										
					25					
					30					

NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual.

* Pocket Penetrometer Strength

109-14,8/6 CDT*JC

EXPLORATORY BORING LOG - EB-3

MORGAN HILL BOX CULVERT
Morgan Hill, California

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services

DRILL RIG: Mobile B-53 SURFACE ELEVATION: – LOGGED BY: CDT

DEPTH TO GROUNDWATER: Not encountered BORING DIAMETER: 6-inch continuous flight DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	LEGEND	CONSISTENCY	SOIL TYPE	DEPTH (FEET)	SAMPLER	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF) *
4 inches asphaltic concrete; 4 inches aggregate baserock.										
Dark brown sandy silty clay, moderate plasticity, fine to coarse grained sand.	A	▨	Stiff	CL/ CH		▒	15	10	–	–
Dark brown silty clay, low plasticity. Trace fine grained sand apparent at 4.0 to 5.5 feet.	A	▨	Very stiff Hard	CL	5	▒ ▒ ▒	14 19 20	19 28 30	3.5 4.3 2.3	9.0 9.0 5.5
Brown gravelly clayey sand, fine to coarse grained, moderate plasticity fines, fine, angular gravel.	B	▨	Medium dense to dense	SC	10		12		–	–
Brown silty clay, low plasticity.	C	▨	Very stiff	CL	15	▒	21	24	2.3	4.5
Brown gravelly clayey sand, fine to coarse grained, low plasticity fines, fine, angular gravel.	B	▨	Very dense	SC	20	▒	9	58	–	–
Bottom of Boring = 20.0 feet. NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual. * Pocket Penetrometer Strength					25 30					

109-14,8/6 CDT*JC

EXPLORATORY BORING LOG - EB-4

MORGAN HILL BOX CULVERT
Morgan Hill, California

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services

DRILL RIG: Mobile B-53
SURFACE ELEVATION: –
LOGGED BY: CDT
DEPTH TO GROUNDWATER: Not encountered
BORING DIAMETER: 6-inch continuous flight
DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	LEGEND	CONSISTENCY	SOIL TYPE	DEPTH (FEET)	SAMPLER	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF) *
5 inches asphaltic concrete; 5 inches aggregate baserock.										
Brown to dark brown gravelly clay with sand, moderate plasticity, fine to coarse, subrounded to subangular gravel, fine to coarse grained sand.	A	▨	Very stiff	CL/CH		▓	10	18	–	–
Black silty clay, high plasticity, trace fine grained sand.	A	▨	Stiff	CH		▓	21	17	1.8	4.0
			Very stiff		5	▓	20 12	18	2.5 –	4.5 –
Brown sandy clay, low plasticity, fine grained sand.	A	▨	Very stiff	CL						
Brown clayey gravelly sand, fine to coarse grained, fine to coarse, angular gravel, low plasticity fines.	B	▨	Medium dense	SC	10	▓	11	27	–	–
Brown silty clay, low plasticity.	C	▨	Very stiff	CL		▓	17 11	22	3.0 –	5.5 –
Brown gravelly silty sand, fine to coarse grained, low plasticity fines, fine, angular gravel.	B	░		SM	15					
Gravel not apparent at 19.5 to 20.0 feet.		░				▓	11	28	–	–
Bottom of Boring = 20.0 feet.					20					
					25					
					30					

NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual.

* Pocket Penetrometer Strength

109-14,8/6 CDT*JC

EXPLORATORY BORING LOG - EB-5

MORGAN HILL BOX CULVERT
Morgan Hill, California

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services

DRILL RIG: Mobile B-53 SURFACE ELEVATION: – LOGGED BY: CDT

DEPTH TO GROUNDWATER: 18.0 feet BORING DIAMETER: 6-inch continuous flight DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	LEGEND	CONSISTENCY	SOIL TYPE	DEPTH (FEET)	SAMPLER	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF) •
5 inches asphaltic concrete; 5 inches aggregate baserock.										
Dark brown silty clay, low to moderate plasticity.	A	▨	Very stiff	CL/CH		▒	13	16	3.5	6.0
color changes to brown at 2.5 feet.		▨				▒	18	36	3.5	9.0+
		▨	Very stiff		5	▒	15	30	4.0	9.0+
		▨			10	▒	16	40	4.0	9.0+
		▨	Very stiff			▒	17	21	3.3	5.5
Brown silty sand, fine to coarse grained, low plasticity fines, trace fine, angular gravel. ○ 23 percent passing the No. 200 sieve	B	░	Medium dense	SM	15	▒ ○	13		–	–
		░					▼			
Gravel content increases at 18.5 to 20.0 feet.		░				▒	11	38	–	--
Bottom of Boring = 20.0 feet.					20					
					25					
					30					

NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual.

• Pocket Penetrometer Strength

109-14,8/6 CDT*JC

EXPLORATORY BORING LOG - EB-6

MORGAN HILL BOX CULVERT
Morgan Hill, California

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services

DRILL RIG: Mobile B-53 SURFACE ELEVATION: – LOGGED BY: CDT

DEPTH TO GROUNDWATER: 19.0 feet BORING DIAMETER: 6-inch continuous flight DATE DRILLED: 7/30/91

DESCRIPTION AND REMARKS	SYMBOL	LEGEND	CONSISTENCY	SOIL TYPE	DEPTH (FEET)	SAMPLER	WATER CONTENT (%)	PENETRATION RESISTANCE (BLOWS/FT.)	SHEAR STRENGTH BY TORVANE (KSF)	UNCONFINED COMPRESSIVE STRENGTH (KSF) *
5 inches asphaltic concrete; 5 inches aggregate baserock.										
Brown silty clay with sand, low plasticity, fine grained sand. ○ Plasticity Index = 20 percent Liquid Limit = 35 percent	A	▨	Hard	CL		▨ ○	14	35	4.5+	9.0
		▨				▨	15	42	4.5+	9.0+
		▨				▨	17	32	4.3	8.0
		▨			5					
		▨	Very stiff							
		▨				▨	16	27	2.5	6.0
		▨			10					
		▨				▨	20	20	2.8	7.0
		▨			15					
Brown clayey sand with gravel, fine to coarse grained, low plasticity fines, fine, angular gravel.	B	▨	Dense	SC		▨	▼ 11	40	–	–
Bottom of Boring = 20.0 feet.					20					
					25					
NOTE: The stratification lines represent the approximate boundary between the soil types. The transition may be gradual. * Pocket Penetrometer Strength					30					

109-14,8/6 CDT*JC

EXPLORATORY BORING LOG - EB-7

MORGAN HILL BOX CULVERT
Morgan Hill, California

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services

Appendix B

APPENDIX B - LABORATORY INVESTIGATION

The laboratory testing program was directed toward a quantitative and qualitative evaluation of the physical and mechanical properties of the soils underlying the site.

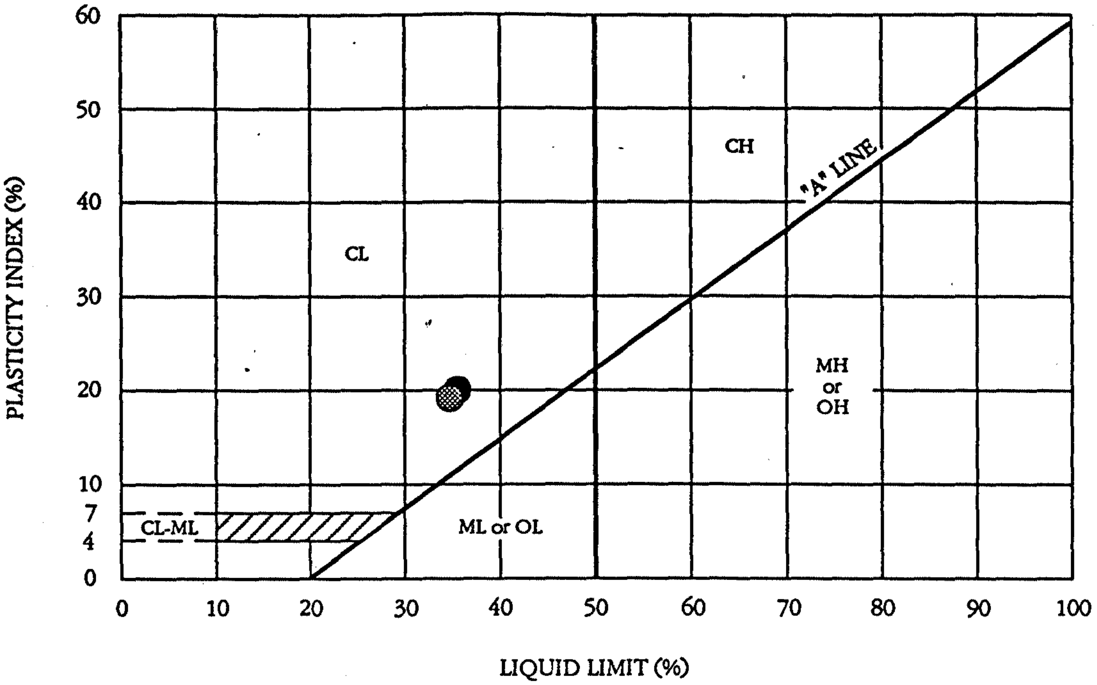
The natural water content was determined on all samples of the materials recovered from the borings. These water contents are recorded on the boring logs at the appropriate sample depths.

One Atterberg Limit determination was performed on a sample of the subsurface soils to measure the range of water contents over which this material exhibits plasticity. The Atterberg Limit was used to classify the soil in accordance with the Unified Soil Classification System and to evaluate the soil's expansion potential. Results of this test are presented on Figure B-1 and on the log of the boring log at the appropriate sample depth.

"R" value (resistance) tests were performed on two representative samples of the surface soils at the site to provide data for pavement design. The tests indicated "R" values of 36 and 29 for Samples No. R-1 and R-2, respectively, at an exudation pressure of 300 pounds per square inch. The results of the tests are presented on Table B-1.

TABLE B-1. RESULTS OF "R" VALUE TESTS

Sample No.	Description of Material	Water Content (%)	Dry Density (pcf)	Exudation Pressure (psi)	"R" value	Expansion Pressure (psf)
R-1	Brown clayey sand with gravel	15.1	114.8	88	12	39
		13.4	118.9	235	28	77
		11.6	122..5	482	54	181
R-2	Brown clayey sand	11.5	122.7	521	41	150
		13.3	117.4	240	18	39
		12.4	121.1	312	30	82



KEY SYMBOL	BORING NO.	SAMPLE DEPTH (feet)	NATURAL WATER CONTENT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	PASSING NO. 200 SIEVE (%)	LIQUIDITY INDEX	UNIFIED SOIL CLASSIFICATION SYMBOL
◍	EB-1	1.0 - 2.5	13	34	19	--	- 0.2	CL
●	EB-7	1.0 - 2.5	14	35	20	--	- 0.1	CL

109-14,8/6 CDT*JC

PLASTICITY CHART AND DATA

MORGAN HILL BOX CULVERT
Morgan Hill, California

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services

FIGURE B-1
109-14, October 1991

Appendix C

APPENDIX C

ANALYTICAL RESULTS AND LABORATORY PROCEDURES

The refrigerated soil samples and the chain of custody form were delivered to Sequoia Analytical Laboratory located in Redwood City, California. Sequoia is certified by the State of California as Hazardous Waste Testing Laboratory. Attached are copies of these results and the chain of custody documentation.

Laboratory testing for selected soil samples consisted of the following analyses to detect the presence of selected EPA compounds:

a. Analysis of selected soil samples for total low and medium boiling petroleum hydrocarbons (gasoline) with a distinction for benzene, toluene, xylene, and ethylbenzene by EPA Method 8015/5030/8020.

b. Analysis of selected soil samples for total high boiling petroleum hydrocarbons (diesel) by EPA Method 8015/3550.

c. Gravimetric methods for determining the total oil and grease content of selected soil samples (SM 5520 E & F).

SEQUOIA ANALYTICAL
680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Lowney Associates	Client Project ID:	P3965 -	Sampled:	Jul 30, 1991
405 Clyde Avenue	Matrix Descript:	Soil	Received:	Aug 1, 1991
Mountain View, CA 94043	Analysis Method:	EPA 5030/8015/8020	Analyzed:	8/9-12/91
Attention: Chris Trumball	First Sample #:	108-0198	Reported:	Aug 14, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS with BTEX DISTINCTION (EPA 8015/8020)

Sample Number	Sample Description	Low/Medium B.P. Hydrocarbons mg/kg (ppm)	Benzene mg/kg (ppm)	Toluene mg/kg (ppm)	Ethyl Benzene mg/kg (ppm)	Xylenes mg/kg (ppm)
108-0198	EB-1, 9.5-10'	N.D.	N.D.	N.D.	N.D.	N.D.
108-0199	EB-1, 5-5.5'	N.D.	N.D.	N.D.	N.D.	N.D.
108-0200	EB-3, 9.5-10'	N.D.	N.D.	N.D.	N.D.	N.D.
108-0201	EB-2, 5-5.5'	N.D.	N.D.	N.D.	N.D.	N.D.
Detection Limits:		1.0	0.0050	0.0050	0.0050	0.0050

LOWNEY ASSOC.
AUG 19 1991
RECEIVED

Low to Medium Boiling Point Hydrocarbons are quantitated against a gasoline standard.
Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Maile McBirney Springer
Project Manager

SEQUOIA ANALYTICAL
680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Lowney Associates
405 Clyde Avenue
Mountain View, CA 94043
Attention: Chris Trumball

Client Project ID:	P3965	Sampled:	Jul 30, 1991
Matrix Descript:	Soil	Received:	Aug 1, 1991
Analysis Method:	EPA 3550/8015	Extracted:	Aug 10, 1991
First Sample #:	108-0198	Analyzed:	Aug 12, 1991
		Reported:	Aug 14, 1991

TOTAL PETROLEUM FUEL HYDROCARBONS (EPA 8015)

Sample Number	Sample Description	High B.P. Hydrocarbons mg/kg (ppm)
108-0198	EB-1, 9.5-10'	N.D.
108-0199	EB-1, 5-5.5'	1.3
108-0200	EB-3, 9.5-10'	N.D.
108-0201	EB-2, 5-5.5'	N.D.

Detection Limits:	1.0

High Boiling Point Hydrocarbons are quantitated against a diesel fuel standard.
Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Maile McBirney Springer
Project Manager

SEQUOIA ANALYTICAL
680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Lowney Associates
405 Clyde Avenue
Mountain View, CA 94043
Attention: Chris Trumball

Client Project ID: P3965
Matrix Descript: Soil
Analysis Method: SM 5520 E&F (Gravimetric)
First Sample #: 108-0198

Sampled: Jul 30, 1991
Received: Aug 1, 1991
Extracted: Aug 5, 1991
Analyzed: Aug 5, 1991
Reported: Aug 14, 1991

TOTAL RECOVERABLE PETROLEUM OIL

Sample Number	Sample Description	Oil & Grease mg/kg (ppm)
108-0198	EB-1, 9.5-10'	N.D.
108-0199	EB-1, 5-5.5'	N.D.
108-0200	EB-3, 9.5-10'	N.D.
108-0201	EB-2, 5-5.5'	N.D.
Detection Limits:		30

Analytes reported as N.D. were not present above the stated limit of detection.

SEQUOIA ANALYTICAL

Maile McBirney Springer
Project Manager

SEQUOIA ANALYTICAL
680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Lowney Associates
405 Clyde Avenue
Mountain View, CA 94043
Attention: Chris Trumball

Client Project ID: P3965

QC Sample Group: 1080198 - 99

Reported: Aug 14, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes
Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Analyst:	B.Cox	B.Cox	B.Cox	B.Cox
Reporting Units:	mg/kg	mg/kg	mg/kg	mg/kg
Date Analyzed:	Aug 9, 1991	Aug 9, 1991	Aug 9, 1991	Aug 9, 1991
QC Sample #:	GBLK080991 MS/MSD	GBLK080991 MS/MSD	GBLK080991 MS/MSD	GBLK080991 MS/MSD
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	200	200	200	600
Conc. Matrix Spike:	180	170	170	510
Matrix Spike % Recovery:	90	85	85	85
Conc. Matrix Spike Dup.:	180	170	170	520
Matrix Spike Duplicate % Recovery:	90	85	85	87
Relative % Difference:	0.0	0.0	0.0	1.9

SEQUOIA ANALYTICAL

Maile McBirney Springer
Project Manager

% Recovery: $\dfrac{\text{Conc. of M.S. - Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$

Relative % Difference: $\dfrac{\text{Conc. of M.S. - Conc. of M.S.D.}}{(\text{Conc. of M.S. + Conc. of M.S.D.}) / 2} \times 100$

SEQUOIA ANALYTICAL
680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Lowney Associates
405 Clyde Avenue
Mountain View, CA 94043
Attention: Chris Trumball

Client Project ID: P3965

QC Sample Group: 1080200 - 01

Reported: Aug 14, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Benzene	Toluene	Ethyl Benzene	Xylenes
Method:	EPA 8020	EPA 8020	EPA 8020	EPA 8020
Analyst:	B.Cox	B.Cox	B.Cox	B.Cox
Reporting Units:	ppb	ppb	ppb	ppb
Date Analyzed:	Aug 9, 1991	Aug 9, 1991	Aug 9, 1991	Aug 9, 1991
QC Sample #:	GBLK081291 MS/MSD	GBLK081291 MS/MSD	GBLK081291 MS/MSD	GBLK081291 MS/MSD
Sample Conc.:	N.D.	N.D.	N.D.	N.D.
Spike Conc. Added:	200	200	200	600
Conc. Matrix Spike:	190	190	180	550
Matrix Spike % Recovery:	95	95	90	92
Conc. Matrix Spike Dup.:	170	190	160	490
Matrix Spike Duplicate % Recovery:	85	95	80	82
Relative % Difference:	11	0.0	12	12

SEQUOIA ANALYTICAL

Maile McBirney Springer
Project Manager

% Recovery: $$\frac{\text{Conc. of M.S. - Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$$

Relative % Difference: $$\frac{\text{Conc. of M.S. - Conc. of M.S.D.}}{\text{(Conc. of M.S. + Conc. of M.S.D.) / 2}} \times 100$$

SEQUOIA ANALYTICAL
680 Chesapeake Drive • Redwood City, CA 94063
(415) 364-9600 • FAX (415) 364-9233

Lowney Associates
405 Clyde Avenue
Mountain View, CA 94043
Attention: Chris Trumball

Client Project ID: P3965 -

QC Sample Group: 1080198 - 01

Reported: Aug 14, 1991

QUALITY CONTROL DATA REPORT

ANALYTE	Diesel	Total Oil & Grease
Method:	EPA 8015	SM5520E&F
Analyst:	R.Lee	V.Nunzir
Reporting Units:	mg/kg	mg
Date Analyzed:	Aug 11, 1991	Aug 5, 1991
QC Sample #:	DBLK081091	BLK080591
Sample Conc.:	N.D.	N.D.
Spike Conc. Added:	15	100
Conc. Matrix Spike:	12	80
Matrix Spike % Recovery:	80	80
Conc. Matrix Spike Dup.:	11	81
Matrix Spike Duplicate % Recovery:	73	81
Relative % Difference:	8.7	1.2

SEQUOIA ANALYTICAL

Maile McBirney Springer
Project Manager

% Recovery:
$$\frac{\text{Conc. of M.S. - Conc. of Sample}}{\text{Spike Conc. Added}} \times 100$$

Relative % Difference:
$$\frac{\text{Conc. of M.S. - Conc. of M.S.D.}}{(\text{Conc. of M.S. + Conc. of M.S.D.}) / 2} \times 100$$

364-9600

COPY

LOWNEYASSOCIATES
CHAIN OF CUSTODY RECORD

JOB NO.	P3965
PROJECT NAME/LOCATION	MORGAN HILL Box CULVERT MORGAN HILL, CA
SAMPLER (S): (Signature)	Chris Turnbull

SHIP TO:

LOWNEY ASSOCIATES
405 Clyde Avenue
Mountain View, CA 94043
415-967-2365
415-967-2785 (FAX)

ANALYSIS REQUIRED

DATE	TIME	SAMPLE DESCRIPTION	NO. OF CONTAINERS	O+G, 5520B+F	~~[illegible]~~ TPH DEISEL	TPH GAS/BTEX	REMARKS
7/30/91	9:00	EB-1, 9.5-10', SOIL	1	X	X	X	1080198
7/30/91	9:45	EB-1 5-5.5' SOIL	1	X	X	X	TWO WEEK 1080199
7/30/91	10:45	EB-3, 9.5-10', SOIL	1	X	X	X	1080200
7/30/91	11:30	EB-2, 5-5.5', SOIL	1	X	X	X	1080201

Relinquished by: (Signature)	Date	Time	Received By: (Signature)	Relinquished by: (Signature)	Date	Time	Received By: (Signature)
Chris Turnbull	8/1/91	2:30	Joe Jencks	Joe Jencks	8/1/91	4:20PM	

Laboratory of Record:	Date	Time	Received for Laboratory By: (Signature)	Date	Time	Remarks:
SEQUOIA						

Appendix D

APPENDIX D
GUIDE SPECIFICATIONS - SITE EARTHWORK
FOR
CONCRETE BOX CULVERT
MORGAN HILL, CALIFORNIA

GENERAL

Scope of Work

These specifications and applicable plans pertain to all site earthwork including, but not limited to, the furnishing of all labor, tools, and equipment necessary for site clearing and stripping, disposal of excess materials, excavation, preparation of foundation materials for receiving fill, and placement and compaction of fill to the lines and grades shown on the project grading plans.

Performance

The Contractor warrants all work to be performed and all materials to be furnished under this contract against defects in materials or workmanship for a period of _____ year(s) from the date of written acceptance of the entire construction work by the Owner or his representative.

Upon written notice of any defect in materials or workmanship during said ____-year period, the Contractor shall, at the option of the Owner, repair or replace said defect and any damage to other work caused by or resulting from such defect without cost to the Owner. This shall not limit any rights of the Owner under the "acceptance and inspection" clause of this contract.

The Contractor shall be responsible for the satisfactory completion of all site earthwork in accordance with the project plans and specifications. This work shall be observed and tested by a representative of J. V. Lowney & Associates, hereinafter known as the Geotechnical Engineer. Both the Geotechnical Engineer and the Architect/Engineer are the Owner's representatives. If the Contractor should fail to meet the technical or design requirements embodied in this document and on the applicable plans, he shall make the necessary adjustments until all work is deemed satisfactory as determined by the Geotechnical Engineer and the Architect/Engineer. No deviation from the specifications shall be made except upon written approval of the Geotechnical Engineer or Architect/Engineer.

No site earthwork shall be performed without the presence or review of the Geotechnical Engineer. The contractor shall notify the Geotechnical Engineer at least twenty-four hours prior to commencement of any aspect of the site earthwork.

The Geotechnical Engineer shall be the Owner's representative to observe the grading operations during the site preparation work and placement and compaction of fills. He shall make visits to the site to familiarize himself generally with the progress and quality of the work. He shall make tests and/or observations to enable him to form an opinion regarding the adequacy of the site preparation, the acceptability of the fill material, and the extent to which the compaction of the fill, as placed, meets the specification requirements. Any fill that does not meet the specification requirements shall be removed and/or recompacted until the requirements are satisfied.

In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for working conditions at the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and shall not be limited to normal working hours.

Any construction review of the Contractor's performance conducted by the Geotechnical Engineer is not intended to include review of the adequacy of the Contractor's safety measures in, on, or near the construction site.

Upon completion of the construction work, the Contractor shall certify that all compacted fills and foundations are in place at the correct locations, have the correct dimensions, and have been constructed in accordance with sound construction practice. In addition, he shall certify that the materials used are of the types, quantity, and quality required by the plans and specifications.

Site and Foundation Conditions

The Contractor is presumed to have visited the site and to have familiarized himself with existing site conditions and the report entitled "Geotechnical Investigation for Concrete Box Culvert, Morgan Hill, California." This report has been prepared for the use of Ducket-Wilson for specific application to the design of the proposed Sequoia Hospital physicians parking structure in accordance with generally accepted geotechnical engineering practices. The Contractor shall not be relieved of liability under the contract for any loss sustained as a result of any variance between conditions indicated by or deduced from the soil report and the actual conditions encountered during the course of the work.

The Contractor shall, upon becoming aware of surface and/or subsurface conditions differing from those of the original soils investigation, notify the Owner within 24 hours of such discovery as to the nature and extent of the differing conditions, first verbally to permit verification of the conditions, and then in writing. No claim by the Contractor for any conditions differing from those anticipated in the plans and specifications and disclosed by the soil investigation will be considered unless the Contractor has not notified the Owner, verbally and in writing, as required above, of such changed conditions.

Dust Control

The Contractor shall assume responsibility for the alleviation or prevention of dust nuisance on or about the site and/or off-site borrow areas. The Contractor shall assume all liability, including court costs of codefendants, for all claims related to dust or windblown materials attributable to his work.

DEFINITION OF TERMS

STRUCTURAL FILL - All soil or soil-rock material placed at the site in order to raise grades or to backfill excavations, and upon which the Geotechnical Engineer has made sufficient tests and/or observations to enable him to issue a written statement that, in his opinion, the fill has been placed and compacted in accordance with the specifications requirements.

ON-SITE MATERIAL - Material obtained from the required site excavations.

IMPORT MATERIAL - Material obtained from off-site borrow areas.

ASTM SPECIFICATIONS - The latest edition of the American Society for Testing and Materials Standards.

RELATIVE COMPACTION - The ratio, expressed as a percentage, of the in-place dry density of the compacted fill material to the maximum dry density of the same material as determined by ASTM Test Designation D-1557-70.

SITE PREPARATION

Clearing, Grubbing, and Stripping

The Contractor shall accept the site in its present condition and shall remove from the area of the designated project earthwork all deleterious materials including any buried utility lines, old building foundations, asphalt paving, concrete slabs, debris, and any other matter determined by the Geotechnical Engineer to be deleterious. Such materials shall become the property of the Contractor and shall be removed from the site. Holes resulting from the removal of deleterious material shall be cleared and backfilled with structural fill.

The site shall be stripped to a minimum depth of 4 inches or to such greater depth as the Geotechnical Engineer in the field may consider as advisable to remove all surface vegetation and organic laden topsoil. Stripped topsoil with an organic content in excess of 3 percent by volume shall be stockpiled for possible use in landscaped areas.

EXCAVATION

All excavation shall be performed on the lines and grades and within the tolerance specified on the project grading plans. All over-excavation below the grades specified shall be backfilled at the Contractor's expense and shall be compacted in accordance with the specifications. The Contractor shall assume full responsibility for the stability of all temporary construction slopes at the site.

If blasting is required, the Contractor shall obtain any required blasting permits, and shall conform to the applicable requirements of local, state, and federal laws and regulations governing such operations.

SUBGRADE PREPARATION

Surfaces to receive compacted fill, and those on which concrete slabs and pavements will be constructed, shall be scarified to a minimum depth of 6 inches and compacted. All ruts, hummocks, or other uneven surface features shall be removed by surface grading prior to placement of any fill materials. All areas which are to receive fill material shall be accepted by the Geotechnical Engineer prior to the placement of any fill materials.

GENERAL REQUIREMENTS FOR FILL MATERIAL

All fill material must be acceptable to the Geotechnical Engineer. The material shall be a soil or soil-rock mixture which is relatively free from organic matter or other deleterious substances. The fill material shall not contain rocks or rock fragments over 6 inches in greatest dimension and not more than 15 percent shall be over 2.5 inches in greatest dimension. Some larger rocks may be incorporated into the lower portions of the fill if the rocks are widely spaced and if the spacing method is acceptable to the Geotechnical Engineer. On-site material having an organic content of less than 3 percent by volume is suitable for use as fill in all areas except where non-expansive import material is specified.

All imported fill material shall be non-expansive with a sand equivalent of 10 or more.

PLACING AND COMPACTING FILL MATERIAL

All structural fill shall be compacted by mechanical means to produce a minimum degree of compaction of 90 percent as determined by ASTM Test Designation D-1557-70. Fills greater than 5 feet in thickness shall be compacted to at least 95 percent relative compaction. Field density tests shall be performed in accordance with either ASTM Test Designation D-1556-82 (Sand Cone Method) or ASTM Test Designation D-2922-81 and D-3017-78 (Nuclear Probe Method). The locations and number of field density tests shall be determined by the Geotechnical Engineer. The results of these tests and compliance with these specifications shall be the basis upon which satisfactory completion of work shall be judged by the Geotechnical Engineer.

Fill material shall be placed in uniform lifts not exceeding 8 inches in uncompacted thickness.

Before compaction begins, the fill shall be brought to a water content that will permit proper compact by either: (1) aerating the fill if it is too wet, or (2) moistening the fill with water if it is too dry. Each lift shall be thoroughly mixed before compaction to provide a uniform distribution of moisture.

TRENCH BACKFILL

Pipeline trenches shall be backfilled with compacted structural fill placed in lifts not exceeding 8 inches in uncompacted thickness. Sufficient water shall be added during the trench backfilling operations to prevent the soil from bulking during compaction. If on-site soil is used, the material shall be compacted by mechanical means to a minimum degree of compaction of 85 percent. Imported sand may also be used for backfilling trenches provided it is compacted to at least 90 percent. In all building pad and pavement areas, the upper 3 feet of trench backfill shall be compacted to a minimum degree of compaction of 90 percent for on-site soils and 95 percent where imported sand backfill is used. The upper 6 inches of all trench backfill in pavement areas shall be compacted to at least 95 percent relative compaction.

PAVEMENT SUBGRADE AND BASE COURSES

The upper 6 inches of pavement subgrade and all aggregate base and aggregate subbase shall be compacted to at least 95 percent relative compaction. Asphaltic concrete, aggregate base, aggregate subbase, and preparation of the subgrade shall conform to and be placed in accordance with the California Department of Transportation, Standard Specifications, latest edition, except that the test method for compaction shall be determined by ASTM D-1557, latest edition.

TREATMENT AFTER COMPLETION OF EARTHWORK

After the earthwork observations have been completed and the Geotechnical Engineer has finished his observation of the work, no further earthwork operations shall be performed except with the review of and under the observation of the Geotechnical Engineer.

It shall be the responsibility of the Contractor to prevent erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.